

## WHAT IS CLAIMED IS:

1. A method for determining a level of ventilatory assist to a ventilator-dependent patient, comprising:
  - 5       calculating a critical threshold of a respiration-related feature, wherein fatigue of a respiratory muscle of the ventilator-dependent patient develops when the critical threshold is reached by the respiration-related feature; and
  - controlling the level of ventilatory assist to the ventilator-dependent patient in relation to the critical threshold of the respiration-related feature so as
  - 10       to prevent fatigue of the patient's respiratory muscle.
2. A method for determining a level of ventilatory assist as defined in claim 1, wherein:
  - calculating a critical threshold of the respiration-related feature comprises
  - 15       calculating a critical signal strength of an electrical activity of the patient's respiratory muscle above which muscle fatigue develops; and
  - controlling the level of ventilatory assist comprises preventing the signal strength of the electrical activity of the patient's respiratory muscle to exceed the critical signal strength to prevent fatigue of the respiratory muscle.
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3. A method for determining a level of ventilatory assist as defined in claim 2, wherein calculating a critical signal strength of the electrical activity of the patient's respiratory muscle comprises:
  - calculating a critical value of a relative spectral change of the electrical
  - 25       activity of the patient's respiratory muscle above which long term fatigue of the respiratory muscle develops; and
  - using the critical value of the relative spectral change to calculate the critical signal strength of the electrical activity of the patient's respiratory muscle.
- 30       4. A method for determining a level of ventilatory assist as defined in claim 2, wherein calculating a critical signal strength of the electrical activity of the patient's respiratory muscle comprises:

determining a critical respiratory muscle force level above which muscle fatigue starts to develop; and

in response to the critical respiratory muscle force level, calculating a critical signal strength of the electrical activity of the patient's respiratory muscle  
5 under which isometric fatigue of the respiratory muscle does not develop.

5. A method for determining a level of ventilatory assist as defined in claim 1, wherein:

calculating a critical threshold of the respiration-related feature comprises  
10 calculating a critical level of a transdiaphragmatic pressure of the ventilator-dependent patient above which muscle fatigue develops; and

controlling the level of ventilatory assist comprises preventing the patient's transdiaphragmatic pressure to exceed the critical level of the transdiaphragmatic pressure to prevent fatigue of the respiratory muscle.

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6. A method for determining a level of ventilatory assist as defined in claim 5, wherein calculating a critical level of the transdiaphragmatic pressure comprises:

calculating a critical value of a relative spectral change of the electrical  
20 activity of the patient's respiratory muscle above which long term fatigue of the respiratory muscle develops;

calculating a respiratory duty cycle; and

using the critical value of the relative spectral change and the respiratory duty cycle to calculate the critical level of the transdiaphragmatic pressure.

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7. A method for determining a level of ventilatory assist as defined in claim 1, wherein calculating a critical threshold of the respiration-related feature comprises:

calculating a first critical signal strength of an electrical activity of the  
30 patient's respiratory muscle above which muscle fatigue develops; and

determining a critical muscle force level above which muscle fatigue develops and, in response to the critical muscle force level, calculating a second

critical signal strength of the electrical activity of the respiratory muscle under which isometric fatigue of the respiratory muscle does not develop; and wherein controlling the level of ventilatory assist comprises preventing the signal strength of the electrical activity of the respiratory muscle to exceed either the  
5 first and second critical signal strengths to prevent fatigue of the respiratory muscle.

8. A method for determining a level of ventilatory assist as defined in claim 1, wherein calculating a critical threshold of the respiration-related feature  
10 comprises:

calculating a critical level of a transdiaphragmatic pressure above which muscle fatigue develops; and

calculating a critical signal strength of an electrical activity of the patient's respiratory muscle above which muscle fatigue develops; and

15 wherein controlling the level of ventilatory assist comprises:

preventing the transdiaphragmatic pressure to exceed the critical level of the transdiaphragmatic pressure to prevent fatigue of the patient's respiratory muscle; and

preventing the signal strength of the electrical activity of the patient's  
20 respiratory muscle to exceed the critical signal strength to prevent fatigue of the patient's respiratory muscle.

9. A method for determining a level of ventilatory assist as defined in claim 1, wherein the patient's respiratory muscle comprises the patient's  
25 diaphragm.

10. A device for determining a level of ventilatory assist to a ventilator-dependent patient, comprising:

a calculator of a critical threshold of a respiration-related feature, wherein  
30 fatigue of a respiratory muscle of the ventilator-dependent patient develops when the critical threshold is reached by the respiration-related feature; and

a controller of the level of ventilatory assist to the ventilator-dependent

patient in relation to the critical threshold of the respiration-related feature so as to prevent fatigue of the patient's respiratory muscle.

11. A device for determining a level of ventilatory assist as defined in  
5 claim 10, wherein:

the calculator computes a critical signal strength of an electrical activity of the patient's respiratory muscle above which muscle fatigue develops;

the device comprises a detector of the signal strength of the electrical activity of the respiratory muscle; and

10 the controller prevents the signal strength of the electrical activity of the patient's respiratory muscle to exceed the critical signal strength to prevent fatigue of the patient's respiratory muscle.

12. A device for determining a level of ventilatory assist as defined in  
15 claim 11, wherein the calculator:

calculates a critical value of a relative spectral change of the electrical activity of the patient's respiratory muscle above which long term fatigue of the respiratory muscle develops; and

20 uses the critical value of the relative spectral change to calculate the critical signal strength of the electrical activity of the patient's respiratory muscle.

13. A device for determining a level of ventilatory assist as defined in claim 11, wherein the calculator:

25 determines a critical respiratory muscle force level above which muscle fatigue starts to develop; and

in response to the critical respiratory muscle force level, calculates a critical signal strength of the electrical activity of the patient's respiratory muscle under which isometric fatigue of the respiratory muscle does not develop.

30 14. A device for determining a level of ventilatory assist as defined in claim 10, wherein:

the calculator computes a critical level of a transdiaphragmatic pressure

of the ventilator-dependent patient above which muscle fatigue develops;

the device comprises a detector of the patient's transdiaphragmatic pressure; and

the controller prevents the patient's transdiaphragmatic pressure to  
5 exceed the critical level of the transdiaphragmatic pressure to prevent fatigue of  
the patient's respiratory muscle.

15. A device for determining a level of ventilatory assist as defined in  
claim 14, wherein the calculator:

10 calculates a critical value of a relative spectral change of the electrical  
activity of the patient's respiratory muscle above which long term fatigue of the  
patient's respiratory muscle develops;

calculates a respiratory duty cycle; and

uses the critical value of the relative spectral change and the respiratory  
15 duty cycle to calculate the critical level of the patient's transdiaphragmatic  
pressure.

16. A device for determining a level of ventilatory assist as defined in  
claim 10, wherein:

20 the calculator (a) calculates a first critical signal strength of an electrical  
activity of the patient's respiratory muscle above which muscle fatigue develops,  
and (b) determines a critical muscle force level above which muscle fatigue  
starts to develop and, in response to the critical muscle force level, calculates a  
second critical signal strength of the electrical activity of the patient's respiratory  
25 muscle under which isometric fatigue of the respiratory muscle does not  
develop;

the device comprises a detector of the signal strength of the electrical  
activity of the patient's respiratory muscle; and

the controller prevents the signal strength of the electrical activity of the  
30 patient's respiratory muscle to exceed either the first and second critical signal  
strengths to prevent fatigue of the patient's respiratory muscle.

17. A device for determining a level of ventilatory assist as defined in claim 10, wherein:

the calculator (a) calculates a critical level of a transdiaphragmatic pressure above which muscle fatigue develops, and (b) calculates a critical  
5 signal strength of an electrical activity of the patient's respiratory muscle above which muscle fatigue develops;

the device comprises a detector of the patient's transdiaphragmatic pressure, and a detector of the signal strength of the electrical activity of the patient's respiratory muscle; and

10 the controller (a) prevents the transdiaphragmatic pressure to exceed the critical level of the transdiaphragmatic pressure to prevent fatigue of the respiratory muscle, and prevents the signal strength of the electrical activity of the patient's respiratory muscle to exceed the critical signal strength to prevent fatigue of the patient's respiratory muscle.

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18. A device for determining a level of ventilatory assist as defined in claim 10, wherein the patient's respiratory muscle comprises the patient's diaphragm.